Paper No. 23

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte STEVEN HURWITT and ISRAEL WAGNER

Appeal No. 1998-2342
Application No. 08/505,739

HEARD: April 26, 2001

Before WARREN, WALTZ, and TIMM, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the Examiner's final rejection of claims 1-20, as amended by the amendments filed February 28, 1997 and April 30, 2001 which have been entered as per the second advisory action mailed on March 17, 1997 (Paper No. 12). Claims 1-20 are the only claims pending in this application.

BACKGROUND

Appellants invention relates to a method and apparatus for sputter deposition coating. Claims 1, 14, and 20 are illustrative and a copy of the claims are appended to this decision.

The prior art references of record relied upon by the Examiner in rejecting the appealed claims are:

Tanaka	4,894,132	Jan. 16, 1990
Hurwitt et al. (Hurwitt)	4,957,605	Sep. 18, 1990
Sasaki	JP 04-329876	Nov. 18, 1992
Tepman	EP 0 634 782	Jan. 18, 1995

Claims 1-5, 8-11, 13-16, and 18-20 stand rejected under 35 U.S.C. § 102(a) as being anticipated by Tepman. Claims 1-20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Tepman and Sasaki in view of Tanaka and Hurwitt. Appellants divide the claims into three groups typified by independent claims 1, 14, and 20 (Brief, page 5) and provide separate arguments for each of these groups. We, therefore, select claims 1, 14, and 20 for consideration of the issues on appeal. We affirm the rejections with respect to the subject matter of claims 1, 14 and claims 2-8 and 15-19 which stand or fall therewith, but reverse with respect to the subject matter of claim 20 and claims 9-13 which stand or fall with claim 20. Our reasons follow.

OPINION

A preliminary step to every analysis of patentability involves interpreting the claims. During patent examination, claims are to be given their broadest reasonable interpretation. *In re Van Geuns*, 988 F.2d 1181, 1184, 26 USPQ2d 1057, 1059 (Fed. Cir. 1993). The claim language

must be read in light of the specification as it would be interpreted by one of ordinary skill in the art. *In re Sneed*, 710 F.2d 1544, 1548, 218 USPQ 385, 388 (Fed. Cir. 1983). While it would be unreasonable to ignore any interpretive guidance afforded by the specification, *see In re Morris*, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997), it is improper to read limitations from the specification into the claims. *Id*. *See also In re Hyatt*, 211 F.3d 1367, 1372, 54 USPQ2d 1664, 1668 (Fed. Cir. 2000). With this in mind we turn to claim 1.

Claim 1 is directed to a sputter deposition method of coating substrates. The claim is in Jepson format and involves an improvement to a known process of sputter coating using a relatively thick sputtering target whose sputtering surface substantially erodes over its life. The improvement involves "maintaining sputtered film thickness uniformity across the surface of the substrates, from substrate to substrate." The claim recites one method step and that step is directed to changing the spacing between the target and substrate "so as to maintain film thickness uniformity across the surfaces of the substrates."

With regard to "maintaining ... uniformity across the surfaces", the claim does not require a perfectly even coating on each substrate. We note that the specification indicates that there is some deviation in thickness uniformity with the use of the process. See Figure 7. The specification does not state how much deviation is encompassed by the claim language "maintaining ... uniformity." However, the specification indicates that, in semiconductor

manufacturing processes, uniformity in the area of +/- 2 to 5 percent has been demanded (page 2, lines 11-13). Therefore, we conclude that the claim at least encompasses processes in which uniformity is maintained to within +/- 5 percent. Such an interpretation is reasonable in light of the teachings of the specification. Furthermore, we note that claim 1 is not limited to semiconductor manufacture. Thus, non-uniformity in excess of +/- 5 percent may also be encompassed.

In order to maintain thickness uniformity across the surfaces, the claim requires a step of "progressively reducing target-to-substrate spacing as a function of target erosion that will vary the distance from the substrate to the eroded sputtering surface." This limitation requires that the target and substrate move toward each other as the target erodes. The reduction in spacing must be progressive. We take this to mean that the erosion must be compensated for continuously or in a stepwise fashion throughout sputtering. The reduction in spacing is dependent on "target erosion", however, the claim is not limited to changing the spacing on the basis of target geometry. The phrase "target erosion" is broad enough to encompass target erosion depth or another change in the target due to erosion. As the sputtering surface erodes, the spacing must vary. The claim does not limit the type of variation.

Claim 14 is directed to an apparatus. The apparatus includes a substrate holder and cathode assembly which are moveable relative to one another and a motor connected to

accomplish the movement. The apparatus also contains a sensor connected to the target and a controller having a programmed processor connected to the output of the sensor. The program must accomplish two tasks. It must determine spacing as a function of target consumption and it must generate an output signal. The function is one which will change the spacing so as to produce a film of a given film thickness uniformity across the surface of a substrate. We interpret the phrase "a given film thickness uniformity" similarly to "maintaining thickness uniformity" above. Therefore, the program must be capable of producing films with a degree of thickness uniformity on the order of +/- 5 percent. As the claim is not limited to a semiconductor wafer manufacturing apparatus, levels above +/- 5 percent may be encompassed.

Claim 20 is drawn to a sputtering method including a step of deriving target-to-substrate spacing as a function of target erosion. The claim requires that this function be derived through experimentation. The experiments involve measuring film thickness deviations over the surface of the sputtered film at different sputtering distances. After the formula is derived from the thickness deviation measurements, the sputtering process is conducted while changing the target-to-substrate spacing using the empirically derived function.

With these claim limitations in mind, we turn to the prior art rejections.

Claims 1, 14, and 20 are subjected to two rejections. The subject matter of these claims stand rejected as anticipated over Tepman and as obvious over Tepman and Sasaki in view of

Tanaka and Hurwitt. We agree with the Appellants that Tanaka and Hurwitt are not relevant to our consideration of the issues as these two references were added to the rejection to address the limitations found in dependent claims which stand or fall with claims 1, 14, and 20 (Brief, page 14). We also agree with the Appellants' characterization of the rejection under §103 as treating Tepman and Sasaki as two primary references and not as one in view of the other (Brief, page 11). Therefore, we will first address the issues as they apply to both anticipation and obviousness of claim 1 over Tepman and then address the issues as they apply to the obviousness of claim 1 over Sasaki. Then we will progress to claims 14 and 20.

Claim 1

"To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either explicitly or inherently." *In re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1431 (Fed. Cir. 1997). As recognized by Appellants, Tepman compensates for target erosion by maintaining a consistent distance between the substrate wafer and the target and thus maintains a consistent and predictable coating thickness from substrate wafer to substrate wafer over the useful life of the target (Brief, page 7, lines 16-19 citing Tepman, col. 3, lines 44-53). Appellants acknowledge that Tepman progressively reduces target-to-substrate spacing as a function of target erosion as

required by claim 1 (Brief, page 8, lines 9-10). What Appellants point out is that Tepman does not expressly describe maintaining uniformity across the surface of

the wafer substrate. However, Tepman's failure to mention maintenance of uniformity across the surface as a goal does not necessary mean there is no anticipation.

A prior art reference may anticipate when a claim limitation not expressly found in that reference is nonetheless inherent in it. *Atlas Powder Co. v. IRECO Inc.,* 190 F.3d 1342, 1347, 51 USPQ2d 1943, 1947 (Fed. Cir. 1999). While Tepman is silent as to the amount of thickness non-uniformity which occurs, it is reasonable to believe that a deviation of less than +/- 5 percent is inherently maintained. We particularly note that Tepman is directed to semiconductor wafer processing. Appellants indicate that uniformity deviations of less than +/- 5 percent were demanded in semiconductor wafer sputtering (specification, page 2). A small deviation on the order of +/- 5 percent is all the claim requires. See the discussion on claim interpretation above.

The reasonableness of the assertion of inherency is supported by Appellants' specification as well. Note that it is permissible to look to appellant's specification to establish the inherent properties of what is taught in the prior art. *C.f. In re King*, 801 F.2d 1324, 1327, 231 USPQ 136, 138 (Fed. Cir. 1986). Appellants' specification indicates that when the target-to-substrate distance is held constant in a similar process, a deviation of +/- 6.2 percent results after 1500 kWH of usage (Figure 4,

page 17 and 18). Advancing the substrate toward the target to compensate for erosion as done by Tepman would result in much less deviation than in the example in the specification in which the target and substrate are kept stationary. Therefore, it is

reasonable to believe that uniformity is inherently maintained to within +/- 5 percent using the distance variation technique of Tepman. Where, as here, the result is a necessary consequence of what was deliberately intended, it is of no import that Tepman did not discuss the particular result claimed. Mehl/Biophile Int'l Corp. v. Milgraum, 192 F.3d 1362, 1366, 52 USPQ2d 1303, 1307 (Fed. Cir. 1999). Furthermore, we note that claim 1 reasonably encompasses deviations in thickness somewhat above +/- 5 percent as discussed above with respect to claim interpretation.

With regard to the rejection under § 103, Appellants argue that the function of erosion disclosed in the *specification* for determining the spacing that will maintain thickness uniformity is not the same function required by Tepman to maintain deposition rate (Brief, page 12). The difference, if there is one is irrelevant. It is the subject matter of the *claims* which is at issue not what is disclosed in the specification. Claim 1 is not limited to any particular function.

Appellants also argue that Tepman teaches against the derivation and use of Appellants' spacing control function since to do so would defeat the purpose of Tepman's invention and would not achieve the result that Tepman seeks to achieve (Brief, page 12). Tepman need not teach the use of

the function disclosed in Appellants' specification. The erosion function described by Tepman would inherently result in maintenance of uniformity as claimed.

As recognized by Appellants, Sasaki describes a process similar to that of Tepman in which the target and substrate are moved in relation to one another so the distance between the

target and substrate remain constant as the target erodes (Brief, pages 10 and 11). Appellants argue that Sasaki does not accept that one might be better off changing target-to-substrate spacing according to some other function (Brief, page 11). As explained above, claim 1 encompasses any erosion function. Thus, claim 1 would encompass the function disclosed by Sasaki.

Appellants also argue that Sasaki would not tolerate changing the substrate-to-target spacing to maintain distribution uniformity (Brief, page 11). The spacing would not have to be changed. It is reasonable to believe that Sasaki's spacing, similarly to Tepman's spacing, would result in maintenance of thickness uniformity within the levels required by claim 1.

We conclude that the Examiner has established a case of *prima facie* anticipation over Tepman and a *prima facie* case of obviousness over either Tepman or Sasaki in view of Tanaka and Hurwitt with respect to the subject matter of claim 1.

Claim 14

Claim 14 is directed to an apparatus for sputter coating. Appellants do not dispute that Tepman describes an apparatus including a substrate holder, cathode assembly, sensor and motor as required by the claim. Instead Appellants argue that Tepman does not describe a processor programmed to determine spacing as a function that will change the spacing so as to produce a film of given film thickness uniformity across the surface. As discussed above, claim 14 requires

the program be capable of producing films with a degree of thickness uniformity on the order of +/- 5 percent. As the claim is not limited to a semiconductor wafer manufacturing apparatus, levels above +/- 5 percent may be encompassed. The program of Tepman determines target-to-substrate spacing as a function of target consumption and is capable to producing film of a given film thickness uniformity as required by claim 14 (col. 5, lines 42-45). The controller of Tepman is structurally the same. The apparatus of Sasaki is similar in structure. Therefore, we conclude that the Examiner has established a *prima facie* case of anticipation over Tepman and a *prima facie* case of obviousness over Tepman or Sasaki in view of Tanaka and Hurwitt with respect to the subject matter of claim 14.

Claim 20

Claim 20, a method claim, includes steps of measuring the film thickness uniformity across the surfaces of the substrates and based on those measurements, empirically deriving target-to-substrate spacing as a function of target erosion. We agree with Appellants that Tepman does not describe

measuring thickness deviation across the surface or empirically deriving spacing data using such measurements. Furthermore, the Examiner has not established that such measurement and derivation steps would have been obvious from the teachings of Tepman or Sasaki alone or in combination with any of the other relied upon references. Therefore, we reverse both the §102 rejection of claim 20 over Tepman and the §103 rejection of claim 20 over Tepman or Sasaki in view of Tanaka and Hurwitt.

CONCLUSION

To summarize, the decision of the Examiner to reject claims 1-5, 8, 14-16, 18, and 19 under 35 U.S.C. § 102(a) is affirmed. The decision of the Examiner to reject claims 1-8 and 15-19 under 35 U.S.C. § 103 is also affirmed. However, the decision of the Examiner to reject claims 9-11, 13, and 20 under 35 U.S.C. § 102(a) is reversed as is the decision of the Examiner to reject claims 9-13 and 20 under 35 U.S.C. § 103.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED IN PART

CHARLES F. WARREN Administrative Patent Judge	)
THOMAS A. WALTZ Administrative Patent Judge	) BOARD OF PATENT) APPEALS) AND) INTERFERENCES
CATHERINE TIMM Administrative Patent Judge	)

ct/vsh

WOOD, HERRON & EVANS

2700 CAREW TOWER

CINCINNATI, OH 45202

APPENDIX A

Claims 1, 14 and 20

1 . In a sputter deposition method of coating substrates, in a sputter coating vacuum chamber, from a relatively thick sputtering target having a sputtering surface thereon that substantially erodes over its. life, the improvement of maintaining sputtered film thickness uniformity across the surfaces of the substrates, from substrate to substrate, the method comprising the step of:

progressively reducing target-to-substrate spacing as a function of target erosion that will vary the distance from the substrate to the eroded sputtering surface so as to maintain film thickness uniformity across the surfaces of the substrates over the course of coating successive substrates.

14. A sputtering apparatus comprising:

a substrate holder;

a cathode assembly having a sputtering target sufficiently thick that the position of its sputtering surface substantially changes as the target is consumed;

the substrate holder and the cathode assembly being moveable relative to each other;

a sensor operatively related to the target having an output related to the state of consumption of the target;

a controller having a processor programmed to determine target-to- substrate spacing as a function of target consumption that will change the spacing of the substrate from the sputtering surface of the target so as to produce a film of a given film thickness uniformity across the surface of a substrate mounted on the substrate holder from a target in the sensed state of consumption and to generate an output signal based on the result of the determination, the controller having an input connected to the output of the sensor ; and

a motor responsive to the output signal and operatively connected between the cathode assembly and the substrate holder so as to move one relative to the other in accordance with the output signal.

20. A method of maintaining, from substrate to substrate, the uniformity, across the surface of a substrate, of a film sputtered from a relatively thick sputtering target that substantially erodes over its life, the method comprising the step of :

sputtering, from a sputtering target of a given design, a film onto a plurality of substrates at each of a plurality of distances from the target and measuring the film thickness uniformity across the surfaces of the substrates;

based on film thickness uniformity measurements, empirically deriving target-to-substrate spacing as a function of target erosion that will cause a film of a given uniformity to be sputtered onto a substrate from a target of the given design;

sputtering, from a sputtering target of the given design, a film of the given thickness uniformity across the surface of a first substrate; then

determining the state of erosion of the sputtering target; then

changing target-to-substrate spacing in accordance with the empirically derived function; then

sputtering a film of the given uniformity across the surface of a second substrate from the sputtering target.